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JOHN C. STENNIS SPACE CENTER

Space Shuttle Main Engine Testing Fact Sheet

The Space Shuttle Main Engine (SSME) is a high-performance, liquid-fueled rocket engine that was developed to meet the stringent demands of the U.S. Space Shuttle program. The Space Shuttle is the world's first reusable spacecraft with the world's first reusable rocket engines. Three main engines, located at the rear of the shuttle, generate a combined thrust of nearly 1.2 million pounds and provide most of the total power needed to reach orbit. SSMEs use liquid hydrogen and liquid oxygen for fuel to power the shuttle during its 8 1/2-minute flight to orbit. The Rocketdyne Division of Boeing North American Inc., Canoga Park, Calif., developed the SSME for NASA.

Stennis Space Center's Role in SSME Testing

Before the shuttle can safely carry its crew and payload into space, its main engines must pass a series of test firings on the ground. The John C. Stennis Space Center (SSC) in South Mississippi has tested Space Shuttle Main Engine's since May 1975 and will continue SSME testing well into the next century. As NASA's lead center for rocket propulsion testing, SSC is responsible for proving that the engines are ready for flight. The engines are tested individually on one of three large test stands. They are test fired for various lengths of time under different operating conditions to ensure their safety and reliability. Different tests are conducted to achieve specific results. They include:

- Development tests--for research and modifications;
- Certification tests--to confirm that design changes are fully developed and satisfactorily complete;
- Life extension tests--to demonstrate the life expectancy of the engine;
- Reliability tests--to determine the exact limits of engine operation; and
- Flight acceptance tests--to determine if flight engines are ready to be delivered to the Kennedy Space Center, Fla., for installation on the shuttle.

SSC Test Facilities

The SSME test complex has several facilities that provide special services to support testing. Test control centers serve as the central command from where the tests are run. Data acquisition facilities receive and process information from the tests. A high-pressure gas facility receives, stores and distributes gases; and a high-pressure industrial water facility furnishes water to cool the flame deflectors on the test stands. The water comes from a 7 1/2-mile canal system and is stored in a 66 million-gallon reservoir. SSC is surrounded by a 125,828-acre acoustical buffer zone that helps to absorb the low frequency noise and vibrations from the tests.

Block I Engines Now in Service
SSC has already completed all development, certification and flight acceptance testing on Block I SSMEs. The May 1996 launch of the Space Shuttle Endeavour, STS-77, was the first shuttle mission to fly all three Block I SSMEs. Those new engine configurations incorporate sophisticated technology that is expected to increase the SSME' s safety and reliability and require less maintenance.

Testing Begins on New Block II SSME
SSC is now testing a new Block II main engine. Block II engines are expected to be more reliable and less expensive to operate than the original main engines that were designed in the 1970s. Improvements of the Block II design include a Rocketdyne two-duct powerhead, a large throat main combustion chamber and Pratt & Whitney's fuel turbopump. The first flight of Block II engines on the shuttle will be for assembly flights for the International Space Station.

Pratt & Whitney Turbopump Uses Advanced Technology
A key element of the new engine design is the Pratt & Whitney high-pressure alternate fuel turbopump. The turbopump is the heart of a rocket engine. It is an extremely high-powered part of the engine that boosts the pressure of the liquid fuel turning the liquid into a high-pressure gas, which is burned in the combustion chamber. Pratt & Whitney uses an advanced fine-grain casting technique to build its turbopumps. Because the pump is made from a cast mold instead of metal pieces welded together, the casting reduces the number of weld points from 300 to seven, leaving less room for error. The pumps also have single crystal blades and silicon bearings. The new design is expected to lower maintenance, increase operational life and cut costs.

Amazing Facts About the SSME

- The SSME operates at greater temperature extremes than any mechanical system in common use today. The liquid hydrogen fuel is -423 degrees Fahrenheit, the Earth's second coldest liquid. When burned with liquid oxygen, the temperature in the engine' s combustion chamber reaches +6000 degrees Fahrenheit, higher than the boiling point of iron.

- One SSME weighs 7,000 pounds, stands 14 feet tall and generates between 390,000 and 490,000 pounds of thrust. Three engines together generate more than 37 million horsepower. One main engine generates enough thrust to maintain the flight of two 747 airliners.

- The engine's high performance is due to major advancements in rocket engine technology. An electronic controller evaluates the engine 50 times a second, adjusting engine valves to maintain peak performance during flight.

- The SSME's high-pressure fuel turbopump main shaft rotates at 37,000 rpm compared to about 3,000 rpm for an automobile traveling at 60 mph.

For more information about Stennis Space Center's Space Shuttle Main Engine test program, call 1-800-237-1821, or (601) 688-3341, or access the SSME home page on the World Wide Web at "http://www. ssc.nasa.gov/~ssme/" (no quotes).

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Return to Stennis Fact Sheets